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Adari

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(54) **THRUST WASHER INCLUDING RADIALLY EXTENDING CONNECTORS**

(71) Applicant: **Schaeffler Technologies AG & Co. KG**, Herzogenaurach (DE)

(72) Inventor: **Sagar Adari**, Wooster, OH (US)

(73) Assignee: **Schaeffler Technologies AG & Co. KG**, Herzogenaurach (DE)

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(22) Filed: **Oct. 26, 2016**

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(51) **Int. Cl.**

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F16C 33/10	(2006.01)
F16C 33/20	(2006.01)
F16C 33/08	(2006.01)
F16C 17/04	(2006.01)
F16D 13/40	(2006.01)
F16H 41/24	(2006.01)

(52) **U.S. Cl.**

CPC ***F16H 45/02*** (2013.01); ***F16C 17/04*** (2013.01); ***F16C 33/08*** (2013.01); ***F16C 33/1065*** (2013.01); ***F16C 33/201*** (2013.01); ***F16D 13/40*** (2013.01); ***F16H 41/24*** (2013.01); *F16C 2226/74* (2013.01); *F16C 2226/76* (2013.01); *F16C 2361/65* (2013.01); *F16H 2045/0205* (2013.01); *F16H 2045/0221* (2013.01); *F16H 2045/0231* (2013.01); *F16H 2045/0247* (2013.01); *F16H 2045/0263* (2013.01); *F16H 2045/0278* (2013.01)

(58) **Field of Classification Search**

None

See application file for complete search history.

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Primary Examiner — Charles A Fox

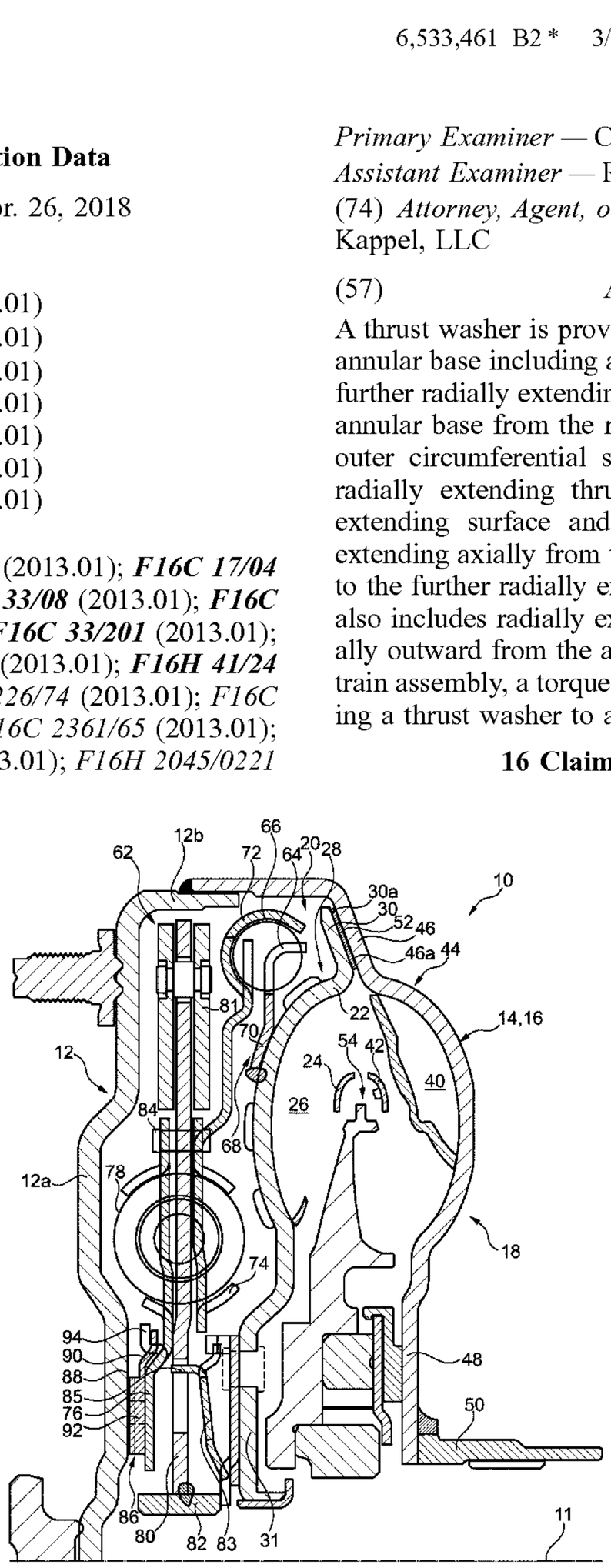
Assistant Examiner — Ryan P Dodd

(74) *Attorney, Agent, or Firm* — Davidson, Davidson & Kappel, LLC

(57) **ABSTRACT**

A thrust washer is provided. The thrust washer includes an annular base including a radially extending thrust surface, a further radially extending surface on an opposite side of the annular base from the radially extending thrust surface, an outer circumferential surface extending axially from the radially extending thrust surface to the further radially extending surface and an inner circumferential surface extending axially from the radially extending thrust surface to the further radially extending surface. The thrust washer also includes radially extending connectors extending radially outward from the annular base. A motor vehicle drivetrain assembly, a torque converter and a method of connecting a thrust washer to a component are also provided.

16 Claims, 5 Drawing Sheets



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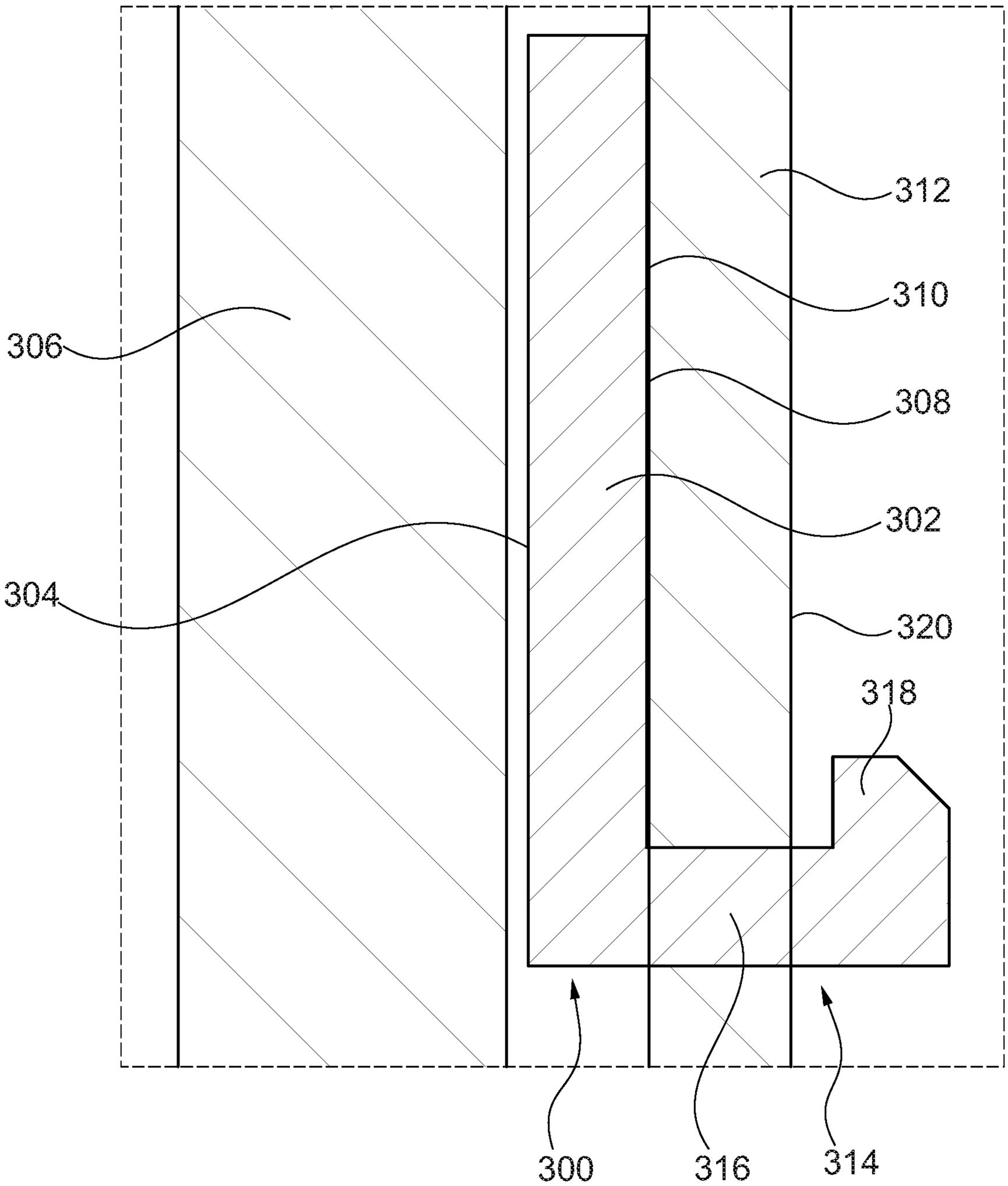
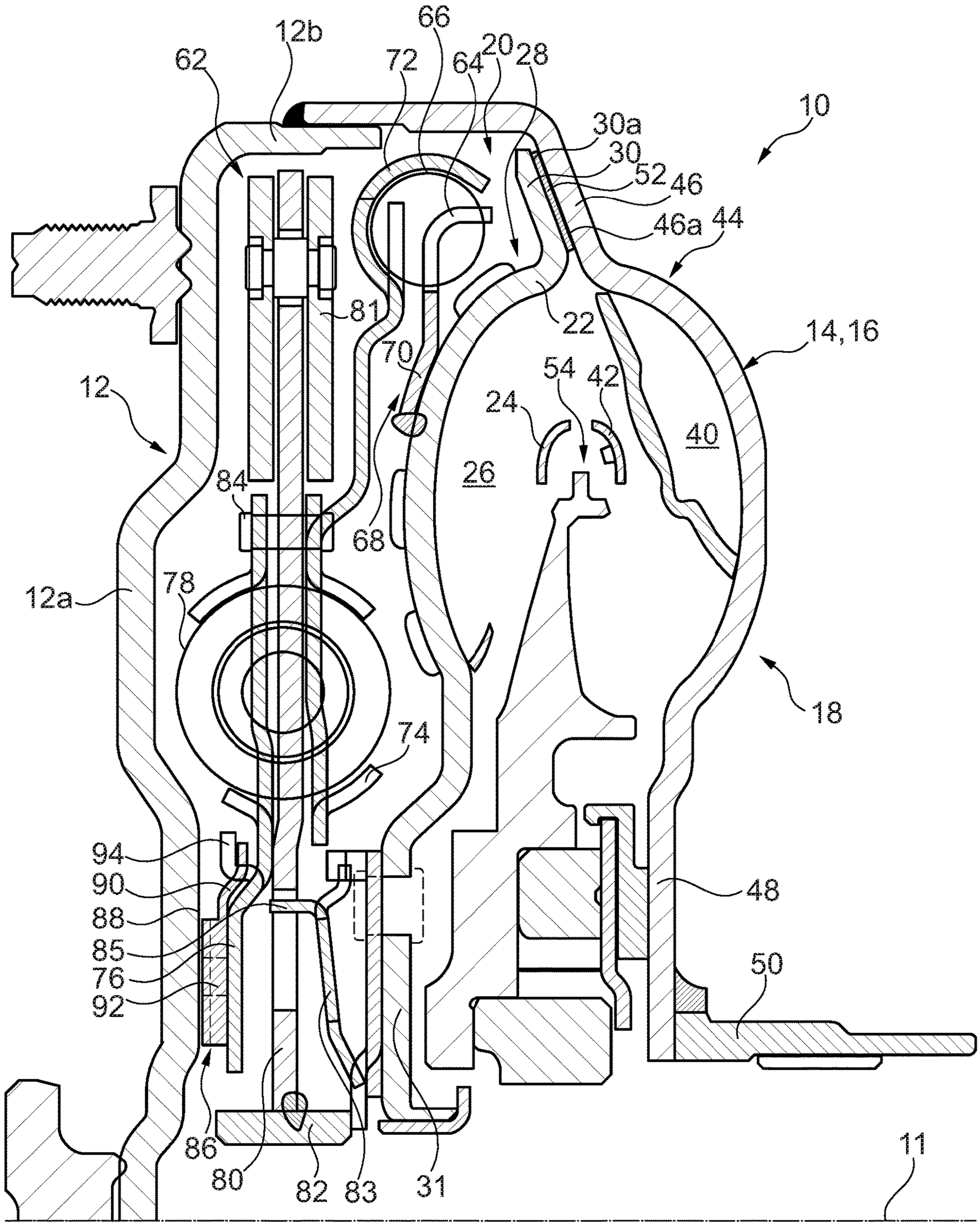


Fig. 1
-Prior Art-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12b
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72
64
20
28
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30a
30
52
46
46a
44
81
22
14,16
70
54
42
12
24
40
26
84
68
12a
78
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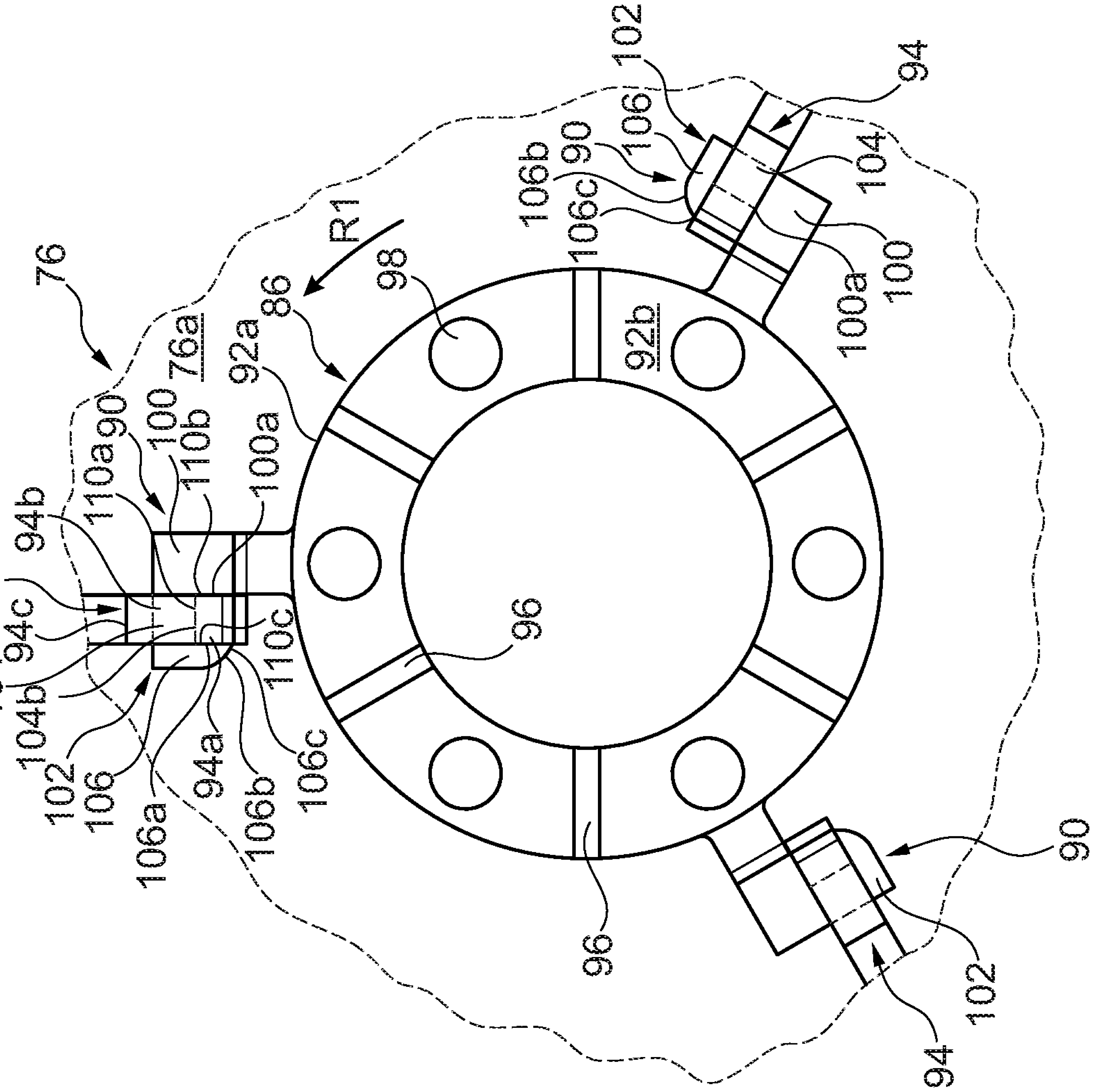
18
94
90
88
85
76
92
48
50
86
80
82
83
31
11

Fig. 2


76
76a
R1
86
92a
92b
98
96
90
94
94a
94b
94c
100
100a
102
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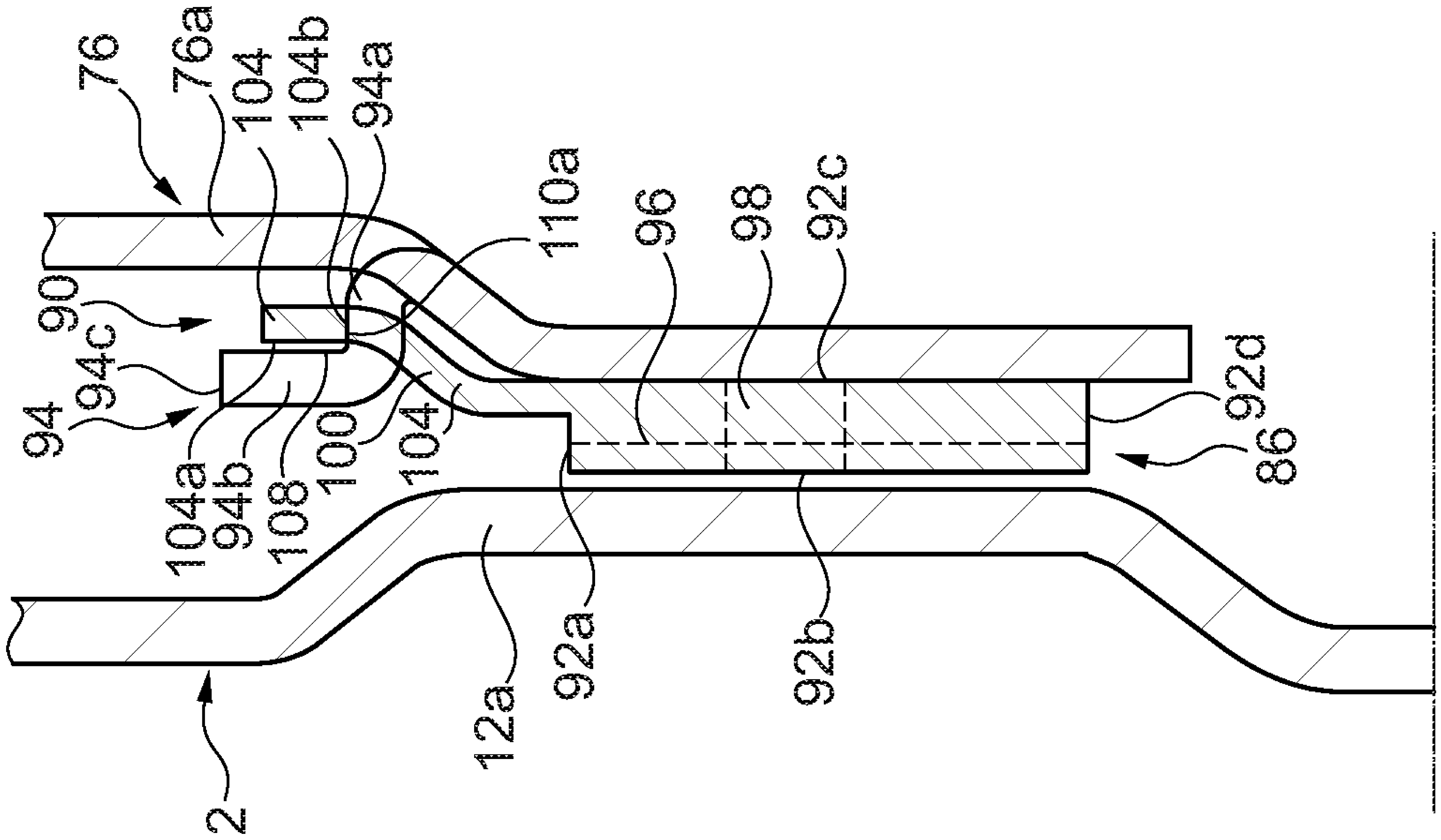
104b
106
106a
106b
106c
110a
110b
110c

Fig. 4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76a
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104a
104b
94
94a
94b
94c
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100
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110a
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98
92a
92b
92c
92d
86
12
12a

Fig. 3

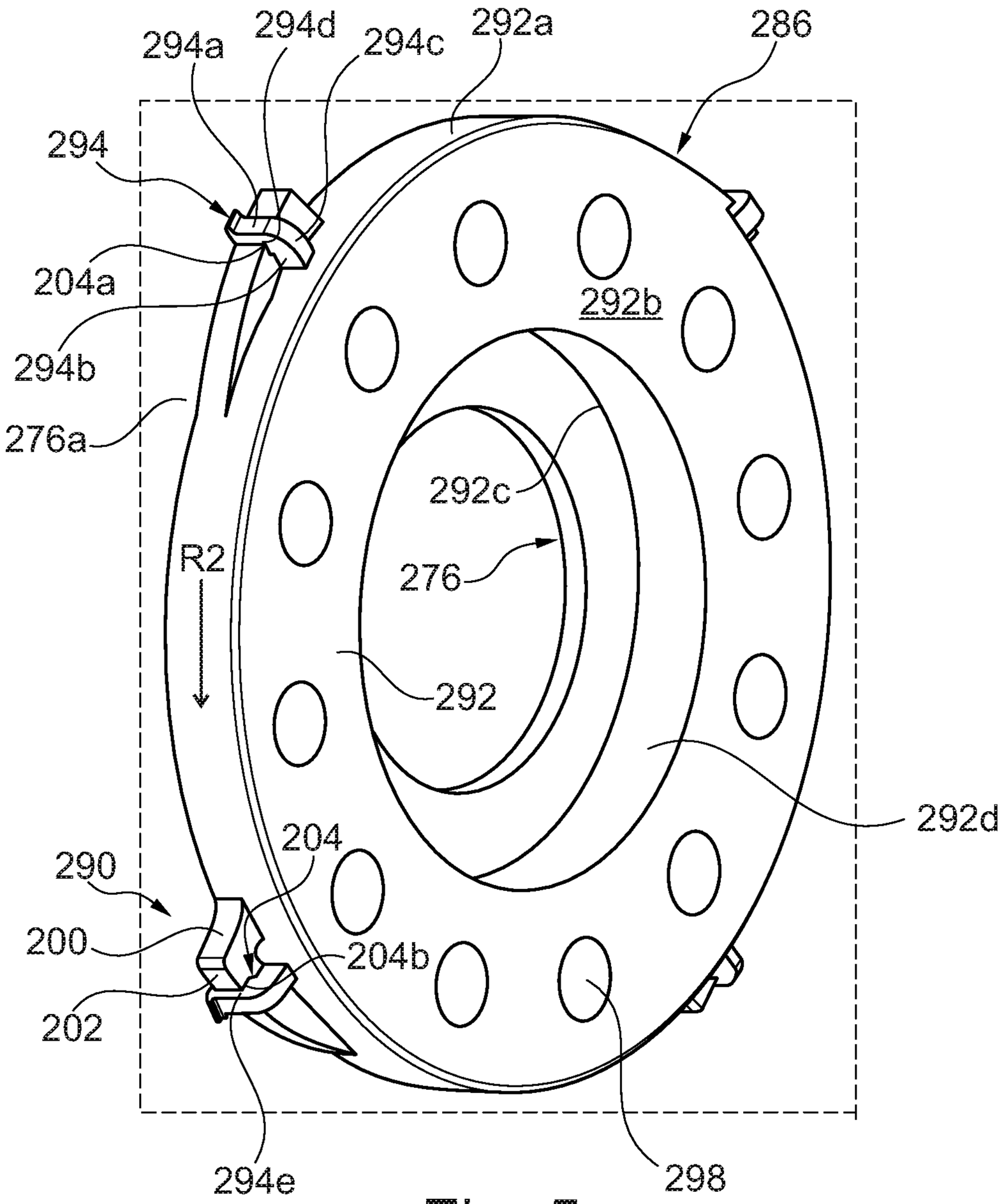
294a
294d
294c
292a
286
294
204a
294b
276a
292b
292c
276
R2
292
292d
204
290
200
204b
202
294e
298

Fig. 5

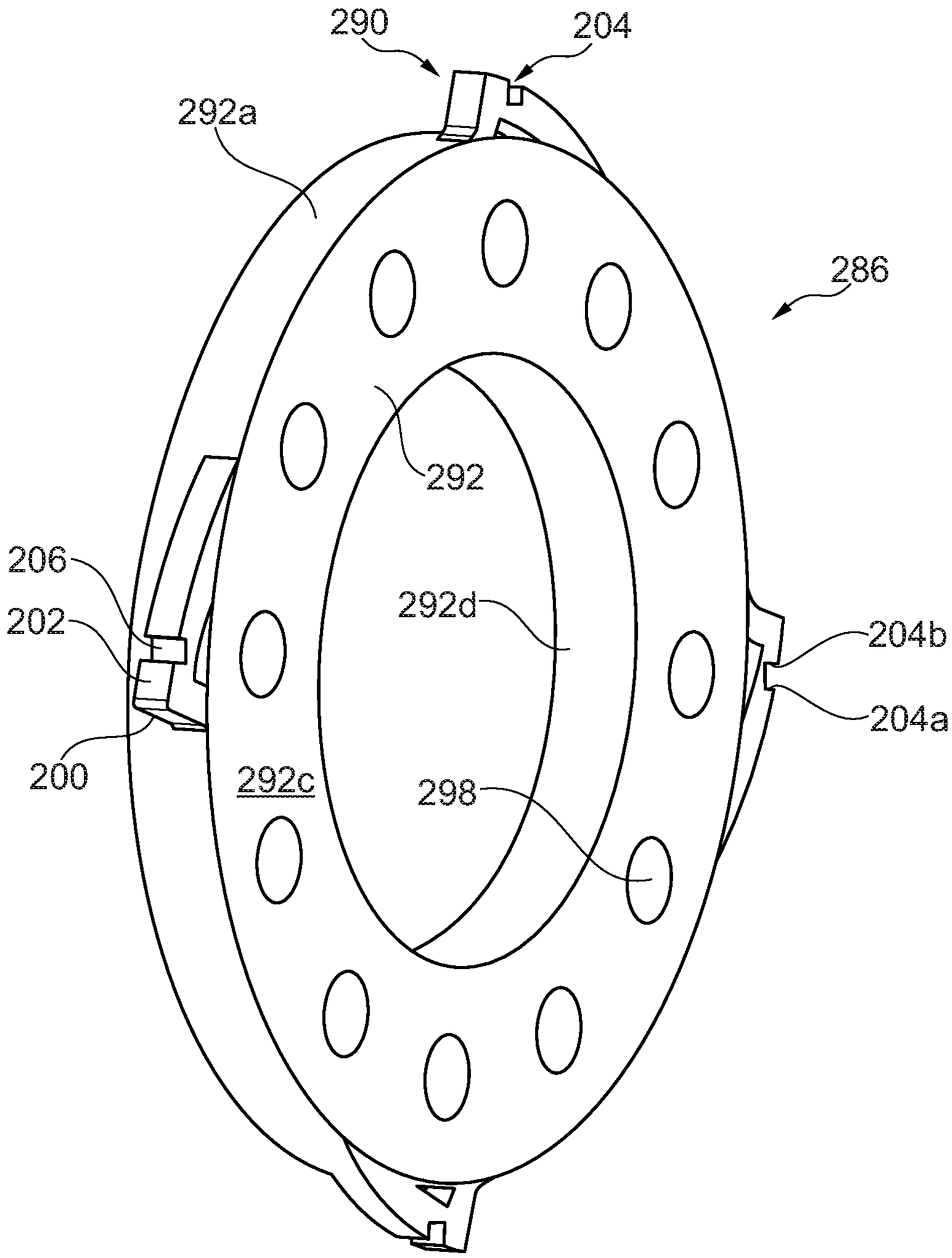

Fig. 6

THRUST WASHER INCLUDING RADIALLY EXTENDING CONNECTORS

The present disclosure relates generally to thrust washer and more specifically to thrust washers for motor vehicle drivetrains.

BACKGROUND

FIG. **1** discloses a conventional thrust washer **300** including an annular base **302** having a low friction surface **304** for contacting a first component **306** and a further opposite surface **308** for contacting a first surface **310** of a second component **312** to which the thrust washer **300** is fixed. The thrust washer **300** includes connectors **314** extending axially from the annular body **302**. The connectors **314** are in the form of axially extending posts **316** for extending axially through the second component **312**. The axially extending posts **316** have radially extending clips **318** for contacting a second surface **320** of the second component **312**.

SUMMARY OF THE INVENTION

A thrust washer is provided. The thrust washer includes an annular base including a radially extending thrust surface, a further radially extending surface on an opposite side of the annular base from the radially extending thrust surface, an outer circumferential surface extending axially from the radially extending thrust surface to the further radially extending surface and an inner circumferential surface extending axially from the radially extending thrust surface to the further radially extending surface. The thrust washer also includes radially extending connectors extending radially outward from the annular base.

A motor vehicle drivetrain assembly is also provided that includes a component including a plurality of circumferentially spaced tabs; and the thrust washer connected to the component by each of the radially extending connectors being connected to one of the tabs.

A torque converter is also provided including the motor vehicle drivetrain assembly in which the component is a cover plate of a damper assembly.

A method of connecting a thrust washer to a component is also provided. The method includes providing a component including a plurality of circumferentially spaced tabs; and connecting the thrust washer to the component by rotating thrust washer such that a clip of each of the radially extending connectors secures a respective axially extending section of one of the tabs.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention is described below by reference to the following drawings, in which:

FIG. **1** shows a cross-sectional side view of a conventional thrust washer;

FIG. **2** shows a cross-sectional side view of a torque converter in accordance with an embodiment of the present invention;

FIG. **3** shows an enlarged cross-sectional side view of a portion of the torque converter shown in FIG. **2**, including a thrust washer in accordance with an embodiment of the present invention;

FIG. **4** shows a plan view of the thrust washer shown in FIG. **3**;

FIG. **5** shows an enlarged perspective side view of a first side of a thrust washer and a portion of a cover plate in accordance with another embodiment of the present invention; and

FIG. **6** shows perspective view of a second side of the thrust washer shown in FIG. **5**.

DETAILED DESCRIPTION

The disclosure provides, for designs in which axial space is limited, a thrust washer including radial clipping tabs as attachment means is disclosed. The tabs extend radially outward from the washer and include circumferentially extending clips to attach to lanced features on the neighboring plate.

FIG. **2** shows a cross-sectional side view of a torque converter **10** in accordance with an embodiment of the present invention. Torque converter **10** is rotatable about a center axis **11** and includes a front cover **12** for connecting to a crankshaft of an internal combustion engine and a rear cover **14** forming a shell **16** of an impeller or pump **18**. The terms axially, radially and circumferentially as used herein are used with respect to center axis **11**. Front cover **12** is substantially cup-shaped and includes a radially extending section **12***a* that intersects and extends radially away from center axis **11** and an annular axially extending section **12***b* that protrudes axially at an outer circumference of section **12***a*.

Torque converter **10** also includes a turbine **20** configured to define a piston that is axially moveable toward and away from impeller **18** to engage and disengage a clutch portion of impeller **18** so as to form a lockup clutch. Turbine **20** includes a turbine shell **22** and a core ring **24** supporting a plurality of turbine blades **26** therebetween. Turbine shell **22** includes a rounded blade supporting portion **28**, which is shaped as an annular bowl, for contacting engine side edges of turbine blades **26**. Radially inside of blade supporting portion **28**, turbine shell **22** includes an annular inner radial extension **31**.

Radially outside of blade supporting portion **28** and turbine blades turbine blades **26**, an outer radial extension **30**, which forms the piston, radially protrudes outwardly from an outer circumference of blade supporting portion **28** to define an annular protrusion having a flat annular radially extending impeller facing surface **30***a* and having an outermost circumference that defines an outermost circumferential surface **30***b* of turbine **20**. Accordingly, the piston and turbine shell **22** are formed as a single piece.

Impeller **18** includes impeller blades **40**, which are each fixed at a transmission side thereof to impeller shell **16** and are each fixed to an impeller core ring **42** at an engine side thereof by tabs. Impeller shell **16**, at radially extending section **14***a* of rear cover **14**, includes a rounded blade supporting portion **44**, which is shaped as an annular bowl, for contacting transmission side edges of impeller blades **42**. Radially outside of blade supporting portion **32** and impeller blades **42**, radially extending section **14***a* includes a radially extending wall **46**, which forms an impeller clutch, radially protrudes outwardly from an outer circumference of rounded blade supporting portion **44** to define an annular wall having a flat annular radially extending turbine facing surface **46***a*. Accordingly, the impeller clutch and impeller shell **16** are formed as a single piece. Radially inside of blade supporting portion **44**, impeller shell **16** includes an annular inner radial extension **48** extending radially inward from blade supporting portion **44**. A radially inner end of extension **48** is connected to an impeller hub **50**.

A friction material **52** is bonded onto radially extending impeller facing surface **30***a* of outer radial extension **30** for engaging radially extending wall **46**. In other embodiments, instead of or in addition to being bonded to outer radial extension **30**, friction material **52** may be bonded to radially extending turbine facing surface **46***a* of radially extending wall **46**. Regardless of whether friction material **52** is bonded to outer radial extension **30** or radially extending wall **46**, friction material **52** is provided axially between surfaces **30***a*, **46***a*. Torque converter **10** also includes a stator **54** axially between turbine **20** and impeller **18** to redirect fluid flowing from the turbine blades **26** before the fluid reaches impeller **18** to increase the efficiency of torque converter **10**.

A damper assembly **62** is positioned between front cover **12** and turbine **20** and is configured for transferring torque from turbine **20** to a transmission input shaft that is splined to the damper hub **82**. In this embodiment, damper assembly **62** is connected to the turbine piston **20** for rotation therewith by drive tabs **64** circumferentially engaging a radially outer set of springs **66** of damper assembly **62**. Drive tabs **64** as formed as part of a drive ring **68** fixed to a front cover facing surface of turbine shell **22** at blade supporting portion **28**. An annular base **70** of drive ring **68** is fixed in contact with front cover facing surface of turbine shell **22** by welding, brazing or riveting. Drive tabs **64** are circumferentially spaced from each other and extend into spaces formed circumferentially between springs **66** to contact circumferential edges of springs **66**. Springs **66** are retained by a spring retainer **72** that wraps around a contour of the outer diameter of springs **66** and is formed at a radially outer end of a first or turbine side cover plate **74** of damper assembly **62**. Damper assembly **62** further includes a second or front cover side cover plates **76**.

Cover plates **74**, **76** support a set of circumferentially spaced radially inner springs **78**, which are radially inside of springs **66**, axially therebetween. Damper assembly **62** also includes a drive flange **80** positioned axially between cover plate **74**, **76** including a hub **82** at a radially inner end thereof configured for nonrotatably connecting to the transmission input shaft. Radially outside of springs **78**, cover plates **74**, **76** are fixed together by a plurality of circumferentially spaced rivets **84**. Drive flange **80** includes circumferentially extending slots for receiving springs **66** formed therein and a centrifugal pendulum absorber **81** at a radially outer end thereof. Damper assembly **66** also includes a turbine-side bias spring **83**, which in this embodiment is a diaphragm spring, provided axially between flange **80** and inner radial extension **31** of turbine **20**. Bias spring **83** includes a plurality of radially and axially extending tabs **85** for interacting with ramps of flange **80** such that relative circumferential motion between drive flange **80** and bias spring **83** generates a force on turbine piston **20**. When damper assembly **62** travels into the coast direction, tabs **85** of bias spring **83** contracts ramps of flange **80** to produce an axial force that is transmitted by bias spring **83** to turbine piston **20**.

In accordance with an embodiment of the present invention, a thrust washer **86** is provided at a front cover side of second cover plate **76** to contact an inner surface **88** of radially extending section **12***a* of front cover **12** to prevent cover plate **76** from contacting front cover **12** during rotation thereof about axis **11** in a manner that generates wear-causing friction. As described further below, thrust washer **86** includes radially extending connectors **90** protruding radially from an outer circumferential surface **92***a* of an annular body **92** thereof that fix thrust washer **86** to cover plate **76** by extending circumferentially around tabs **94** of cover plate **76**.

FIG. **3** shows an enlarged cross-sectional side view of thrust washer **86** and portions of cover plate **76** and radially extending section **12***a* of front cover **12**. FIG. **4** shows a plan view of thrust washer **86**. As shown in FIGS. **3** and **4**, cover plate **76** is provided with lanced tabs **94** formed by lancing a base portion **76***a* of cover plate **76**. Tabs **94** protrude from base portion **76***a* axially toward radially extending section **12***a* of front cover **12**. Tabs **94** each include an axially extending section **94***a* extending from base section **76***a* toward front cover section **12***a* and a radially extending section **94***b* extending radially outward from axially extending section **94***a* to form a free end **94***c* of tab **94**.

On a first side thereof facing front section **12***a*, annular body **92** of thrust washer **86** includes a low friction radially extending thrust surface **92***b* for contacting inner surface **88**, while on a back side thereof facing cover plate **76**, annular body **92** includes a further radially extending surface **92***c* contacting cover plate. In one preferred embodiment, thrust washer **86** is formed of a polymer such as Torlon such that thrust surface **92***b* is low friction. Outer circumferential surface **92***a* and an inner circumferential surface **92***d* of annular body **92** extend axially between radially extending surfaces **92***b*, **92***c*. Thrust surface **92***b* includes a plurality of circumferentially spaced radially extending grooves **96** provided therein extending from inner circumferential surface **92***d* to outer circumferential surface **92***a* allowing for fluid to flow radially through annular body **92**. Circumferentially between each of grooves **96**, annular body is provided with through holes **98** extending axially from front surface **92***b* to rear surface **92***c*.

Connectors **90** extend radially outward from outer circumferential surface **92***a*. More specifically, connectors **90** each include an arm **100** extending radially from outer circumferential surface **92***a* into a circumferentially extending clip **102** that wraps around the corresponding tab **94**. Clip **102** includes a circumferentially extending portion **104** extending circumferentially from arm **100** and a radially extending portion **106** extending radially back toward outer circumferential surface **92***a*. In other words, arm **100** is directly connected to annular base **92** at outer circumferential surface **92***a* and circumferentially extending portion **104** extending circumferentially from an outer radial end of arm **100** to radially extending portion **106**. At the end of circumferentially extending portion **104** that is opposite the end joining arm **100**, radially extending portion **106** extends radially inward from circumferentially extending portion **104** back toward annular base **92**.

Arm **100** also extends axially away from annular base **92** toward base portion **76***a* of cover plate **76** and extends axially past a rear side surface **108** of radially extending section **94***b* of tab **94**, with a front side surface **104***a* of circumferentially extending portion **104** directly facing and/or contacting rear side surface **108** and an inner surface circumferentially extending surface **104***b* of circumferentially extending portion **104** contacting an outer circumferentially extending surface **110***a* of axially extending section **94***a*.

Axially extending section **94***a* of tab **94** is sandwiched circumferentially between radially extending edge **100***a* of arm **100** and a radially extending edge **106***a* of radially extending portion **106** of clip **102**, with a first radially extending edge **110***b* of axially extending section **94***a* contacting radially extending edge **100***a* and a second radially extending edge **110***c* of axially extending section **94***a* con-

tacting radially extending edge **106***a*. To install connectors **90** onto tabs **94**, radially extending portions **106** of clips **102** are each aligned adjacent to the respective radially extending tab edge **110***b* such that an inclined surface **106***b* of each radially extending clip portion **106** contacts a radially outer end of edge **110***b*, where surface **110***a* and edge **110***b* meet, and thrust washer **86** is rotated in a rotational direction R1 such that contact between inclined surface **106***b* and the radially outer end of edge **110***b* forces the respective clip **102** radially outward, such that an innermost edge **106***c* of radially extending portion **106** slides along surface **110***a* as thrust washer **86** is rotated, until each innermost edge **106***c* reaches edge **110***c* and the respective clip **102** snaps radially inward such that edge **106***a* contacts edge **110***c* and the clip **102** is wrapped around the respective tab **94**, connecting the thrust washer **86** to the cover plate **76**.

FIG. **5** shows an enlarged perspective side view of a first side, here an engine-side, of a thrust washer **286** and a portion of a cover plate **276** in accordance with another embodiment of the present invention. FIG. **6** shows perspective view of a second side, here a transmission-side, of thrust washer **286**. Cover plate **276** is provided with tabs **294**, which may be formed by lancing a base portion **276***a* of cover plate **276**. Tabs **294** each include an axially extending section **294***a* extending from base section **276***a* and a radially extending section **294***b* extending radially inward from axially extending section **294***a* to form a free end **294***c* of tab **294**.

On the first side thereof, an annular body **292** of thrust washer **286** includes a low friction radially extending thrust surface **292***b* for contacting inner surface **88** of front cover **12** (FIG. **2**), while on a back side thereof facing cover plate **276**, annular body **292** includes a further radially extending surface **292***c* contacting cover plate **276**. In one preferred embodiment, thrust washer **286** is formed of a polymer such as Torlon such that thrust surface **292***b* is low friction. An outer circumferential surface **292***a* and an inner circumferential surface **292***d* of annular body **292** extend axially between radially extending surfaces **292***b*, **292***c*. In one embodiment, thrust surface **292***b* can include a plurality of circumferentially spaced radially extending grooves similar to grooves **96** (FIG. **4**). Annular body **292** is provided with through holes **298** extending axially from front surface **292***b* to rear surface **292***c*.

Connectors **290** extend radially outward from outer circumferential surface **292***a*. More specifically, connectors **290** each include a radially extending surface **200** extending radially from outer circumferential surface **292***a* and an inclined surface **202**, which is arc-shaped and extends circumferentially and radially outward from outer circumferential surface **292***a* and into the outer edge of radially extending surface **200**. Surface **202** form an outer circumferential surface of connector **290** and is provided with a clip **204** that wraps around a radially inner portion of axially extending section **294***a* of the corresponding tab **294**. Clip **204** is defined by two radially extending surfaces **204***a*, **204***b* of a groove **206** formed in outer circumferential surface **202**. The first radially extending surface **204***a* contacts a radially extending surface **294***c* of axially extending section **294***a* and the second radially extending surface **204***b* contacts a radially extending surface **294***d* of axially extending section **294***a*.

When thrust washer **286** is connected to cover plate **276**, axially extending section **294***a* of tab **294** is sandwiched circumferentially between radially extending surfaces **204***a*, **204***b*. To install connectors **290** onto tabs **294**, circumferentially and radially extending surfaces **202**, which form ramps, are each aligned adjacent to the respective radially inner surface **294***e* of axially extending section **294***a* of tab **294**, and thrust washer **286** is rotated in a rotational direction R2 such that contact between inclined surface **202** and radially inner surface **294***e* of axially extending section **294***a* forces axially extending section **294***a* of tab **294** radially outward until each axially extending section **294***a* snaps radially inward into the respective groove **206** and surfaces **204***a*, **204***b* contact the respective surface **294***c*, **294***d*, connecting the thrust washer **286** to the cover plate **276**.

In the preceding specification, the invention has been described with reference to specific exemplary embodiments and examples thereof. It will, however, be evident that various modifications and changes may be made thereto without departing from the broader spirit and scope of invention as set forth in the claims that follow. The specification and drawings are accordingly to be regarded in an illustrative manner rather than a restrictive sense.

What is claimed is:

1. A thrust washer comprising:

an annular base including a radially extending thrust surface, a further radially extending surface on an opposite side of the annular base from the radially extending thrust surface, an outer circumferential surface extending axially from the radially extending thrust surface to the further radially extending surface and an inner circumferential surface extending axially from the radially extending thrust surface to the further radially extending surface; and

radially extending connectors extending radially outward from the annular base, each of the radially extending connectors including a radially extending arm extending radially outward from the outer circumferential surface of the annular base and a circumferentially extending clip extending circumferentially from the radially extending arm past the radially extending arm,

wherein each of the circumferentially extending clips extends circumferentially from an outer end of the radially extending arm, the radially extending arm including a radially extending surface extending radially outward from the outer circumferential surface of the annular base, the circumferentially extending clip extending circumferentially away from the radially extending arm past the radially extending surface of the radially extending arm.

2. Thrust washer as recited in claim **1** wherein each of the circumferentially extending clips includes a circumferentially extending portion extending circumferentially from the outer end of the radially extending arm and a radially extending portion extending radially inward from the circumferentially extending portion.

3. The thrust washer as recited in claim **1** wherein the radially extending thrust surface includes grooves extending radially from the inner circumferential surface to the outer circumferential surface.

4. A motor vehicle drivetrain assembly comprising:

a component including a plurality of circumferentially spaced tabs; and

a thrust washer comprising:

an annular base including a radially extending thrust surface, a further radially extending surface on an opposite side of the annular base from the radially extending thrust surface, an outer circumferential surface extending axially from the radially extending thrust surface to the further radially extending surface and an inner circumferential surface extending

axially from the radially extending thrust surface to the further radially extending surface; and

radially extending connectors extending radially outward from the annular base,

the thrust washer being connected to the component by each of the radially extending connectors being connected to a respective one of the tabs with a section of each of the tabs being sandwiched circumferentially between two radially extending surfaces of the respective radially extending connector.

5. The motor vehicle drivetrain assembly as recited in claim **4** wherein each of the radially extending connectors includes a radially extending arm extending from the annular base and a circumferentially extending clip extending circumferentially from an outer end of the radially extending arm, each circumferentially extending clip including a circumferentially extending portion extending circumferentially from the outer end of the radially extending arm and a radially extending portion extending radially inward from the circumferentially extending portion, the radially extending arm including a first of the two radially extending surfaces extending radially outward from the outer circumferential surface of the annular base, the circumferentially extending clip including a second of the two radially extending surfaces, the section of each of the tabs being sandwiched circumferentially between two radially extending surfaces of the respective radially extending connector being an axially extending section.

6. The motor vehicle drivetrain assembly as recited in claim **5** wherein an inner surface of the circumferentially extending portion of each of the radially extending connectors contacts an outer surface of the axially extending section of the respective tab.

7. The motor vehicle drivetrain assembly as recited in claim **4** wherein the component includes a base portion, the tabs being lanced from the base portion.

8. The motor vehicle drivetrain assembly as recited in claim **4** wherein each of the radially extending connectors includes an inclined surface and a clip defined by a groove formed in the inclined surface the tabs each including an axially extending section being secured by the clip and being held in the groove.

9. A torque converter comprising:

the motor vehicle drivetrain assembly as recited in claim **4**.

10. The torque converter as recited in claim **9** wherein the component is a cover plate of a damper assembly.

11. The torque converter as recited in claim **10** further comprising a front cover including a radially extending section and an axially extending section, the thrust washer being axially between the radially extending section of the front cover and the cover plate.

12. A method of connecting a thrust washer to a component comprising:

providing a component including a plurality of circumferentially spaced tabs; and

connecting the thrust washer as recited in claim **1** to the component by rotating thrust washer such that the circumferentially extending clip of each of the radially extending connectors secures a respective axially extending section of one of the tabs.

13. The method as recited in claim **12** wherein each circumferentially extending clip including a circumferentially extending portion extending circumferentially from the outer end of the radially extending arm and a radially extending portion extending radially inward from the circumferentially extending portion, the axially extending section of each of the tabs is sandwiched between the radially extending arm and the radially extending portion of the respective radially extending connector when the clip contacts a radially extending edge of the respective axially extending section.

14. The method as recited in claim **12** wherein the component is a cover plate of a damper assembly of a torque converter.

15. A thrust washer comprising:

an annular base including a radially extending thrust surface, a further radially extending surface on an opposite side of the annular base from the radially extending thrust surface, an outer circumferential surface extending axially from the radially extending thrust surface to the further radially extending surface and an inner circumferential surface extending axially from the radially extending thrust surface to the further radially extending surface; and

radially extending connectors extending radially outward from the annular base, each of the radially extending connectors each including two radially extending surfaces circumferentially facing each other,

wherein each of the radially extending connectors including a radially extending arm extending radially outward from the outer circumferential surface of the annular base and a circumferentially extending clip, the radially extending arm including a first of the two radially extending surfaces extending radially outward from the outer circumferential surface of the annular base, the circumferentially extending clip extending circumferentially away from the radially extending arm past the radially extending surface of the radially extending arm, the circumferentially extending clip including a second of the two radially extending surfaces.

16. The thrust washer as recited in claim **15** wherein each of the circumferentially extending clips includes a circumferentially extending portion extending circumferentially from the radially extending arm and a radially extending portion extending radially inward from the circumferentially extending portion, the radially extending portion of the circumferentially extending clip including the second of the two radially extending surfaces, the circumferentially extending portion extending from the first of the two radially extending surfaces to the second of the two radially extending surfaces.

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